

Challenges of bariatric surgery in adolescents with obesity

Lorena Mihaela Manole^{1,2}, Mădălina Andreea Donos^{1,2}, Laura Otilia Boca², Otilia Elena Frăsinariu^{3,4}, Laura Mihaela Trandafir^{3,4}

1. "IOSUD" Grigore T. Popa" University of Medicine and Pharmacy, Iasi, Romania

2. "Sf. Maria" Children's Emergency Hospital, Iasi, Romania

3. "Grigore T. Popa" University of Medicine and Pharmacy, Mother and Child Department Iasi, Romania

4. Ilrd Paediatric Clinic, "Sf. Maria" Children's Emergency Hospital, Iasi, Romania

Abstract. Challenges of bariatric surgery in adolescents with obesity

Objective: Obesity is a multifactorial condition and one of the most frequent pathology encountered in practice worldwide, who took a big increase of prevalence in children and adolescents after the SARS-COV-2 pandemic period. The aim of this review is to evaluate the surgical treatment options, outcomes, and clinical indications in adolescents with severe obesity, focusing on types of procedures, nutritional management and resolution of metabolic comorbidities. **Materials and method:** In this review we analysed the most relevant published studies (original papers and reviews) in the scientific literature. The literature search of articles was made in electronic international indexed databases PubMed, Medline and Web of Science. The papers published up to November 2022 were searched with the following keywords: obesity, adolescents, bariatric surgery, obesity complications, metabolic risk, sleeve gastrectomy, clinical indications for bariatric surgery. **Results:** The bariatric surgery is a safe and effective treatment for the population younger than 18 years, with durable weight loss and improvement in comorbid conditions. Laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass are the most common bariatric surgery procedures performed in both adolescent and adult patients, with an average percent body mass index loss between 25-29% after surgery. In bariatric surgery is recommended a multidisciplinary approach to evaluate the eligible candidates, especially for an adolescent. Following the bariatric surgery, the patients must optimize their lifestyle habits and make healthy dietary choices. Multiple studies have demonstrated important improvements, prevention and even remission of complications of obesity. Psychosocial issues and the quality of life are important components in evaluating the patients diagnosed with obesity. **Conclusions:** The prevention and treatment of obesity and comorbidities in adolescence are key strategic goals, in order to reduce morbidity, mortality in adulthood. The early results in bariatric surgery, made in both sleeve gastrectomy or Roux-en-Y gastric bypass technique, have all indicated that adolescent surgical intervention is a successful therapeutic option, if lifestyle modifications fail.

Keywords: obesity, adolescents, bariatric surgery, weight loss, sleeve gastrectomy, Roux-en-Y gastric bypass

INTRODUCTION

Obesity is a complex, multifactorial condition and one of the most frequent pathology encountered in practice worldwide, which after the SARS-COV-2 pandemic period took a rapid increase of prevalence in children and adolescents, which almost tripled. By increasing the prevalence of overweight and obesity, both in the paediatric population and in adults, there is a high risk of comorbidities with multiple social and economic consequences [1].

The prevalence of obesity over time has almost tripled since 1975 according to the World Health Organization. In 2016, there were more

than 650 million obese adults, with age 18 years and older (13%), and for children and adolescents

Corresponding author: Lorena Mihaela Manole, manole.lorena@yahoo.com

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(5-19 years) the prevalence has increased dramatically from 4% in 1975 to 18% in 2016. Worldwide, there are 340 million overweight or obese children, of which respectively 124 million obese patients (6% of girls and 8% of boys) [2].

Obesity in adolescents represents a strong predictor of morbidity and mortality in adulthood and due to the serious implications and risks, it urgently needs effective treatments. Lifestyle interventions and pharmacological treatment are limited and do not always achieve weight loss in the long term or improve comorbidities. Bariatric surgery has become a therapeutic strategy in adolescents [3] and it is increasingly considered around the world. This procedure is an effective treatment for adults in numerous studies and with various benefits on weight loss and reducing the risk of comorbidities. Most studies about this topic on adolescents demonstrate average percent body mass index loss between 25-29% after surgery. This fact is also associated with resolution or improvement of most complications of obesity at rates that are similar or superior to adult studies [4].

The techniques in bariatric surgery commonly performed have evolved over time and older surgical procedures have been replaced with safer and more effective operations [5]. In the 1991 NIH Consensus Statement described the vertical banded gastroplasty and Roux-en-Y gastric bypass (RYGB) as the most predominant procedures used in clinical practice at the time. In present time, the procedures used are sleeve gastrectomy and RYGB, which are performed worldwide for approximately 90% of all operations [6], and each has well-studied mid- and long-term outcomes.

Other surgical procedures performed include adjustable gastric banding, biliopancreatic diversion with duodenal switch and one-anastomosis gastric bypass. The vertical banded gastroplasty is of historical interest and is no longer performed. The popularity of the adjustable gastric banding has diminished significantly over the past decade. Metabolic bariatric surgery (MBS) is preferably performed over the world using minimally invasive surgical approaches (laparoscopic or robotic assisted) [5].

Obesity in adolescence is associated with persistent obesity, increased risk for related comorbidities and premature mortality in adulthood [7,8]. Bariatric surgery is worldwide considered for the treatment of adolescents with severe obesity, but there are not so many adolescent-specific studies examining the efficacy and safety of weight-loss surgery available to support clinical decision making. The aim of this review is to evaluate the clinical indications in adolescents with severe obesity, surgical treatment options, focusing on types of procedures, outcomes, nutritional management and resolution of metabolic comorbidities.

MATERIAL AND METHODS

In this review we identified and critically analysed the most relevant published studies (Original papers and reviews) in the scientific literature. The literature search of articles was made in electronic international indexed databases PubMed, Medline and Web of Science. The papers published up to November 2022 in each author's field of expertise were searched with the following keywords: obesity, adolescents, bariatric surgery, obesity complications, metabolic risk, sleeve gastrectomy, clinical indications for bariatric surgery. The resulting draft was discussed among authors to provide a theoretical point of view. The final version was then communicated and approved by all the co-authors.

RESULTS AND DISCUSSIONS

Obesity in childhood and adolescence represents a troublesome public health problem which affects the majority of developed countries [9]. Bariatric surgery is taken in consideration in adolescents with moderate to severe obesity who have previously been treated with a lifestyle medicine approach with unsuccessful results [10].

In the last years, many countries reported an increase in obesity rates in children and adolescents caused by COVID-19 restrictions, unhealthy choices concerning everyday meals, school closures, along with other measures, have disrupted the everyday routine of children, adolescents and even young adults, leading to changes in their eating behaviours and physical

activities [11]. Because of the COVID-19 pandemic were found significant increases in body weight and BMI during the lockdown period among children and adolescents [12].

The revised guidelines published in 2022 by the American Society for Metabolic and Bariatric Surgery Paediatric Committee with recommendations about bariatric surgery for children and adolescents stating that the procedure is safe for the population younger than 18 years, with durable weight loss and improvement in comorbid conditions [5].

A reported study of 3-year outcome data from the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS), a prospective multiinstitutional observational study of 242 adolescents undergoing MBS, was the marker of a turning point in the treatment of severe obesity in children [13]. While prevention remains the mainstay of obesity policy, in children who develop severe obesity, it has become clear that MBS is a safe and effective treatment for the adolescents and should be considered more readily by primary care physicians [14].

The American Academy of Paediatrics and the ASMBS recommend consideration of metabolic and bariatric surgery in children/adolescents with BMI >120% of the 95th percentile (the class II obesity) and major comorbidities or a BMI >140% of the 95th percentile (class III obesity) [14,15]. In addition, according to Alqahtani AR. et al. and guidelines, the bariatric surgery does not negatively impact pubertal development or linear growth, and therefore a specific Tanner stage and bone age should not be considered a requirement for surgery [16]. In addition, syndromic obesity, developmental delay, autism spectrum or history of trauma are not considered a contraindication to bariatric surgery in adolescents [17]. A shared requirement by the different guidelines in literature is important to evaluate the patient's ability and the parental support to adhere to the postoperative dietary regimen, including micronutrient administration.

In bariatric surgery is recommended a multidisciplinary approach to evaluate the eligible candidates, especially for an adolescent [18,19]. This includes a bariatric surgeon with

experience for adolescents, paediatrician, dietitian, nurse, and paediatric psychologist, anaesthesiologists, radiologists, and appropriate specialists to aid the management of complications in obesity (e.g., pulmonology, endocrinology, gastroenterology/hepatology). Also, it is important that the multidisciplinary team have to determine the potential patients and caregivers' ability to assess the risks and benefits of surgery as well as to adhere to postoperative requirements including daily vitamin supplements and attending postoperative management [4].

According to Interdisciplinary European Guidelines on Metabolic and Bariatric Surgery the indications for bariatric surgery in adolescents and children should be considered in centres with extensive experience of such treatment in adults and paediatric category and who are able to provide a true multidisciplinary approach, which require paediatric skills in surgery, nutrition advice and psychological management [20].

The eligibility criteria for bariatric surgery are: 1. patients with BMI > 40 kg/m² (or 99th percentile for respective age) and at least one co-morbidity; 2. previous failure of any dietetic, behavioural or pharmacological intervention, at least 6 months of organized weight reducing attempts in a specialized centre; 3. presents skeletal and developmental maturity; 4. is capable to commit to comprehensive medical and psychological evaluation before and after intervention; 5. decisional capacity to participate in a postoperative multidisciplinary treatment programme in a unit with specialist paediatric support (nursing, anaesthesia, psychology, post-operative care); 6. has access surgery in a unit with specialist paediatric support (nursing, anaesthesia, psychology, post-operative care) [20,21].

In numerous studies, laparoscopic sleeve gastrectomy (SG) and Roux-en-Y gastric bypass (RYGB) are the most common bariatric surgery procedures performed in both adolescent and adult patients [4,22-24]. The Teen Longitudinal Assessment of Bariatric Surgery (Teen-LABS) study reported 3-year mean BMI reductions of 29% with Roux-en-Y gastric bypass and 27%

with vertical sleeve gastrectomy among individuals aged 19 years or younger [13].

Laparoscopic sleeve gastrectomy represents a restrictive procedure that includes resection of 85% of the stomach, along its greater curvature of the stomach resulting in a smaller, tubular stomach with a reduced capacity [22]. The technique of procedure is less complex than the Roux-en-Y gastric bypass and has less risks for micronutrient deficiencies. That makes a more appropriate option for adolescents and currently accounts for approximately 80% of bariatric procedures (4,25-27). A sleeve gastrectomy procedure may also be converted to RYGB in the event additional MBS is indicated or in the situation of postoperative medically refractory gastroesophageal reflux disease [4].

Roux-en-Y laparoscopic gastric bypass is a combination of malabsorptive and restrictive procedure, which involves creating a small and proximal gastric pouch, separated from the remnant stomach and anastomosed to the mid-jejunum (The Roux-limb) of small bowel 70-150 cm distally [4,22]. Following this technique, the incidence of postoperative gastroesophageal reflux disease is significantly less compared to SG, making the procedure an option preferred for adolescents with this pathology [4].

Comparing the procedures in months after the procedures, both SG and RYGB shows similar reduction in BMI, weight regain following surgery and reverse of comorbidities, which indicates that both are effective options for weight loss in adolescence [28].

Both SG and RYGB have significant results in weight loss in adolescents with severe obesity. According to Inge et al. in a large, multicentre analysis of 177 adolescents who underwent RYGB and 306 adolescents who underwent SG, there was a three-year postoperative average percent BMI loss of -29% for RYGB and -25% for SG, respectively [26]. Similar results were seen in the biggest prospective study with 228 adolescents undergoing either RYGB or SG with an average 28% reduction in BMI at three years following RYGB compared to 26% reduction following SG [13]. Smaller, long-term studies demonstrate the durability of weight loss with MBS with an

average percent BMI loss of 29% in adolescents undergoing RYGB up to 12 years after surgery [29,30].

The laparoscopic approach is minimally invasive and that is the reason why became the preferred technique in bariatric surgery, more commonly adopted in children and adolescents. The specific laparoscopic instrumentation includes longer trocars, longer instruments and bougie devices (34–36 F) useful to adjust the thicker abdominal wall of patients with obesity. The patient is placed in the supine position, in reverse Trendelenburg and the surgeon stands between the legs of the patient. The procedure is performed with four trocars: a 12 mm trocar in the umbilicus for the 30-degree laparoscope, two operative trocars (5 and 15 mm) to the left and right of the umbilicus and a 5 mm trocar in the left hypochondrium (or subxiphoid area) for liver retraction [10].

SG is the most commonly procedure performed bariatric surgery in adolescents and has gained more acceptances in the past decade, because it has lower perioperative complications including less dumping syndrome, less iron malabsorption, and less re-operations [22].

Following the bariatric surgery, the patients must optimize their lifestyle habits and make healthy dietary choices. The adolescents and their families must be counselled on the key role of healthy and personalized diet and supplements that need to be regularly taken in order to reduce the risk of nutrient deficiencies after the surgical procedure [31]. Lifelong supplementation with vitamins and minerals is recommended following both surgery procedures and also, lifelong annual monitoring of nutritional and micronutrient status, with adjustments in supplements if it is needed to be made over time [4].

Schmoke et al. present that postoperative complications after SG or RYGB procedure in the immediate period are: nausea, vomiting and dehydration, anastomotic leak, gastric tube twist and volvulus. Also, the wound infection at the trocar site is also a recurrent complication described in patients with severe obesity (0.6%) [4]. In the long-term outcome, the principal risk of complication is primarily nutritional. The

patients should have regular reassessment of complications after the surgical intervention for the early intervention, if they occur. The adolescents are particularly at risk for deficiencies in iron, vitamin D and vitamin B12 [4]. Iron deficiency anaemia has the risk to be severe in adolescent women following bariatric surgery which can be complicated by menstruation and difficulties in recognizing symptoms, therefore daily supplementation and routine nutritional monitoring is essential after MBS [4]. Adolescents have the risk to experience substantial decreases in bone mineral density [32] and the main reason could be low vitamin D levels.

According to the Teen-LABS study, following MBS cholelithiasis is a common complication due to rapid weight loss in adolescence and adulthood. That is the reason of required cholecystectomy within three years in 9.9% of adolescents who underwent RYGB and 5.1% who underwent SG [13]. Also, a long-term complication is developing oesophageal disease such as Barrett's oesophagus in patients with gastroesophageal reflux disease [10]. According to Chalklin et al. the risk of reoperation in the 5 years after RYGB appears to be slightly higher in adolescents compared to adults (20–25%), but the recent improvements in surgery technique and post-operative management have led to important reductions in the principal causes of reoperation after bariatric surgery [33].

Multiple studies have demonstrated important improvements, prevention and even remission of complications of obesity. According to the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS), a prospective, observational study of paediatric patients undergoing MBS, of the 242 adolescents with obesity who underwent MBS, 29 patients had Type 2 Diabetes Mellitus. After 3 years since the procedure, remission of Type 2 Diabetes occurred in 95% of patients who had diabetes at baseline and 19 patients with prediabetes presented a 76% rate of remission at 3 years [13].

The significant risk factors for cardiovascular disease in adolescents with severe obesity are hyperlipidaemia, elevated inflammatory markers, hypertension and insulin

resistance [14]. The presence of cardiovascular risk factors, such as dyslipidaemia at an early age, is associated with the presence of cardiovascular disease in adulthood with a high risk for an early and accelerated atherosclerosis [34]. As stated by two different reports by Teeple et al. [35] and Inge et al. [36], there were significant improvements in nearly all investigations of cardiovascular disease risk factors in 2 years check-up after MBS. Numerous cardiovascular disease risk factors improve among adolescents undergoing MBS and increased weight loss, female sex, and younger age predict a higher probability of resolution of those risks [37].

Obesity has strong risk of chronic kidney disease in adulthood and obesity-related nephropathy, which are increasingly recognized in paediatric population, particularly in adolescence [38]. Focal segmental glomerulosclerosis (FSGS) is a form of glomerulonephritis that develops in various renal lesions, evolving with nephrotic-range proteinuria. Fixed and persistent proteinuria over several months may indicate underlying FSGS [39]. Obesity-related glomerulopathy (ORG) is a secondary form of focal and segmental glomerulosclerosis (FSGS) that occurs in patients with severe obesity [40]. In the Teen-LABS study described above 66% presented remission of dyslipidaemia and 86% resolution of abnormal kidney function was found at 3 years [13].

A few studies have demonstrated a remission of obstructive sleep apnea 66% to 84%, of liver disease and polycystic ovarian syndrome [41–43].

In multiple studies of children and adolescents with obesity have been described high rates of depression, emotional, behaviour disorders and even suicidal intentions. Psychosocial issues and the quality of life are important components in evaluating the patients diagnosed with obesity [44]. MBS can lead to improvements in psychosocial outcomes. According to the TEEN-Labs study, the quality of life measured by the Impact of Weight on Quality of Life and Short Form 36 Health Survey has an important improvement after MBS [13,45].

CONCLUSIONS

The prevention and treatment of obesity and comorbidities in adolescence are key strategic goals, in order to reduce morbidity, mortality in adulthood. The number of patients with severe obesity who were refractory to medical treatments increased over time. Laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass are the most common metabolic a procedures performed in both adolescent and adult patients.

The efficacy of weight loss through surgical procedure in adolescents with severe obesity has been presented in recent literature. The early results in bariatric surgery, made in both sleeve gastrectomy or Roux-en-Y gastric bypass technique, have all indicated that adolescent surgical intervention is a successful therapeutic option, if lifestyle modifications fail.

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All authors read and approved the final manuscript.

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